MACHINE FOR YARN CABLING/TWISTING AND CONTINUOUS-SETTING

The invention relates to the technical sector of the setting, cabling or twisting, and crimping of yarns in the textile field.

More specifically, the invention relates to the treatment of textured yarns, that is to say those having an initial crimping resulting from the upstream processes.

Many technical solutions have been proposed for carrying out the operation of cabling and setting continuous yarns. Mention may be made, by way of entirely non-limiting example, of the teaching of Patent US 5 950 412 which relates to a machine comprising a central frame supporting a plurality of identical work positions each comprising:

- a twisting or direct cabling spindle supporting a yarn package, the yarn being intended to be twisted or cabled with a second yarn;
- yarn forwarding means for eliminating the tension that results from the twisting or cabling operation;
- yarn heating means followed by a cooling zone;
- means for winding up the treated yarn;
- the heating means consist of a linear oven placed vertically or approximately vertically;
- the yarn performs an forward-and-return motion inside the said oven and is introduced into and extracted from the latter via its bottom part, a feed and return system for the said yarn being provided in the top part; and
- means are provided for keeping the yarn under a minimum tension during the cooling phase and for delivering it to the wind-up means.

Solutions have also been proposed in which the oven, which is of substantial size, is eliminated, to be replaced with a cylindrical godet associated with a

return guide allowing reeving of the yarn. The godet is heated to a defined temperature and positively driven in rotation. This solution is taken, for example, from the teaching of Patent Application FR 02/01357 (not yet published).

Starting from this prior art, the twofold problem that the invention aims to solve is, on the one hand, that of continuously setting a single yarn at a time, in order to have a very short path yarn, with few points of contact, so as to obtain better twist uniformity of the yarn and, on the other hand, that of controlling the shrinkage of the yarn in order to give it very good crimp characteristics in particular, while allowing it to regain most of its initial crimp. Indeed it is known that the return to the initial crimp is accompanied by a significant shrinkage which must be controlled.

To solve this twofold problem, a machine has been designed and developed for the continuous cabling and/or twisting, and setting of yarns, comprising several treatment stations incorporating, in combination and in succession, within the same work position:

- means for cabling or twisting a yarn;
- heat-setting means consisting of a heated rotary godet which has configurations capable of allowing the shrinkage of the yarn to be controlled, the said configurations consisting of a longitudinal profile defining successive zones that extend over almost the entire length of the said godet, namely an initial crimp pick-up zone, a residual shrinkage zone and a setting zone,
- an accumulator capable of cooling and relaxing the yarn in the completely free, tensionless state; and
- means for winding on or winding up the yarn,

the said means being subjected to means for driving and guiding the yarn.

The fact of combining the three cabling or twisting, heat-setting and winding-on operations makes it possible to substantially reduce the management of material undergoing processing between these three operations. This results in large savings in terms of the necessary labour for management of the in-process stocks and the immobilization of material, and also a reduction in the production cycle.

To solve the problem posed of having the shortest possible yarn path, at the or each treatment station, the cabling or twisting means, heat-setting means and winding-on means are mounted in combination with devices for forwarding the yarn and arrangements of the frame of the said machine, so as to delimit a small and compact space that incorporates the yarn wind-off means, along a yarn path of short length.

To solve the problem posed of being able to control the shrinkage of the yarn:

- the initial crimp pick-up and residual shrinkage zones consist of conical bearing surfaces, while the setting zone consists of a cylindrical bearing surface;

- the two conical bearing surfaces have different cone angles, the residual shrinkage zone having a smaller angle than the initial crimp pick-up zone;

- advantageously, the length of the setting zone is greater than the sum of the lengths of the two other zones.

In another embodiment, the initial crimp pick-up, residual shrinkage and setting zones may consist of a curved profile.

Another problem that the invention aims to solve is to

keep the yarn in contact with the godet for a certain time, in order to set the yarn. For this purpose, the heated godet is subjected to means capable of allowing automatic reeving of the yarn.

Another problem that the invention aims to solve is to ensure complete cooling and relaxation of the yarn after heat-setting in order to create a buffer zone between the heat-setting and the winding-on, in order to continue the heat-setting, continuously during a change of take-up bobbin.

To solve such a problem, the accumulator consists of a hollow straight body, the end of which, considered on the output side, is frustoconical in order to create, within the said body, a buffer zone braking the output of the said yarn by preventing it from leaving directly.

At the outlet of the accumulator, the yarn is subjected to the action of bars capable of uncurling the yarn and giving it the tension needed for winding-on.

In another embodiment, the accumulator consists of a relaxation belt in which the yarn forms a reserve, the said belt being placed between the heated godet and the wind-up means, the wind-up speed being regulated so that the amount of accumulated yarn in reserve is maintained between two predetermined values, a minimum value and a maximum value.

The yarn is deposited in the accumulator through the effect of a relative movement between a guiding element and the accumulator itself.

The relative movement is created by a displacement of the yarn guiding element or by a displacement of the accumulator itself.

In a preferred embodiment of the invention, each treatment station comprises, in succession starting from the wind-off bobbin:

- a yarn cabling or twisting spindle;
- a presser/deliverer member limiting the tension of the yarn and setting a level of twist downstream;
- the heated rotary godet;
- the cooling accumulator;
- the uncurling bars; and
- the winding-on or wind-up bobbin.

The invention will be explained below in greater detail with the aid of the figures of the appended drawings in which:

- Figure 1 is a schematic view showing the principle of how the yarns are treated in one and the same work position that combines the cabling or twisting, heat-setting and winding-on operations;
- Figure 2 is a perspective view of an illustrative example of a machine according to the invention;
- Figure 3 is a schematic view showing an illustrative example of the heated godet;
- Figure 4 is a perspective view of the accumulator; and
- Figure 5 is a longitudinal sectional view of the accumulator.

As shown in particular in Figure 2, the machine comprises a frame (B) with, preferably, a plurality of identical treatment stations. According to the invention, each treatment station incorporates, in combination and in succession, in one and the same work position, means (1) for cabling or twisting a yarn, means (2) for heat-setting the yarn, means (3) for cooling the yarn and means (4) for winding on or winding up the yarn (5).

According to an important feature of the invention,

within each treatment station, the cabling or twisting (1), heat-setting (2) and cooling (3) means and the means (4) for winding on or winding up the yarn (5) are mounted in combination with arrangements of the frame (B) of the machine so as to define a small compact space incorporating the yarn wind-up means (6) along a path of short length (Figure 1).

The yarn cabling or twisting means consist, in a manner perfectly well known to those skilled in the art, of a cabling or twisting spindle for carrying out either a direct cabling operation or a twisting. For example, the spindle, driven by any suitable known means, receives a bobbin of a first yarn to be treated, called a "can yarn". To carry out the direct cabling operation, the spindle has a hollow shaft for feeding a second yarn, called the "creel yarn", coming from the wind-off bobbin (6). The creel yarn is fed through the hollow shaft of the spindle, to be joined with the can yarn within a cabling head (7). This cabling head may be combined with a forwarding means for eliminating the tension resulting from the cabling or twisting. This forwarding means may be composed of an assembly of the type comprising a capstan and a press roll. Such arrangements are not described in detail as they are perfectly well known to those skilled in the art. The reader may for example return to the teaching of the cited Patent US 5 950 412.

The yarn heat-setting means consist of a heated rotary godet (2) followed by an accumulator (3) capable of cooling and relaxing the yarn, making it completely free and tensionless. The godet (2) is heated to a defined temperature and is driven positively in rotation by any suitable known means. For example, the heating means may be of the induction type.

Importantly, the godet (2) has configurations capable of allowing the shrinkage of the yarn to be controlled.

As shown especially in Figure 3, the godet has a longitudinal profile shaped so as to define successive continuous zones that extend over almost its entire length. These zones consist of a pick-up zone (2a), a residual shrinkage zone (2b) and a setting zone (2c).

For example, the two zones (2a) and (2b) consist of conical bearing surfaces, while the setting zone (2c) consists of a cylindrical bearing surface. The conical bearing surfaces (2a) and (2b) have different angles. Thus, the residual shrinkage zone (2b) has a smaller cone angle α than the cone angle β of the initial crimp pick-up zone (2a).

This figure also shows that the residual shrinkage zone (2b) has a greater length than the pick-up zone (2a). Likewise, the length of the setting zone (2c) is greater than the sum of the lengths of the two other zones (2a) and (2b). The illustrated example therefore shows that the three zones (2a), (2b) and (2c) result from a succession of bearing surfaces of different length and cone angle.

Of course, without departing from the scope of the invention, other profiles that can produce the same functions with a view to producing the same results may be envisaged. For example, the godet (2) may have a curved longitudinal profile.

Owing to the features of the heated godet (2), it is possible to set the cabled or twisted yarn so as to give it very good crimp characteristics.

Within the initial crimp pick-up zone (2a), the contact of the yarn on the heated godet creates a shock effect, allowing the yarn to take up its initial crimp. The return to the crimp is accompanied by a significant shrinkage which must be controlled. This control is obtained by the cone angle β of the conical bearing

surface (2a). After the yarn has been given this shock effect, the residual shrinkage zone (2b) allows the yarn to complete its shrinkage gently and uniformly, given the smaller cone angle α of the conical bearing surface (2b), which is longer than the conical bearing surface (2a).

Within the cylindrical zone (2c), the yarn is set under the conditions to which it was subjected in the two previous zones. Owing to the large length of the cylindrical bearing surface (2c), the setting of the yarn takes place gently.

Owing to these arrangements in the two conical zones, the yarn retains its original tension, but undergoes shrinkage. The yarn has a tendency to rotate on itself as its tension gradually increases. It follows that all the portions of the yarn are in contact with the godet, which ensures a completely round shape of the yarn. The conical profile and the textile control means that the yarn necessarily has a calculated shrinkage.

It may also be observed that, for setting the yarn, the latter must remain for a certain time in contact with the various zones of the godet (2). To increase this contact time, it is known to carry out a yarn reeving operation on the godet. This reeving operation may be performed manually or automatically.

After leaving the heated godet (2) assembly, the yarn is subjected to the action of an accumulator (3) capable of completely cooling and relaxing the yarn after heat-setting and of creating a buffer zone between the heat-setting and the winding-on, allowing continuation of the heat-setting, continuously during a change of take-up bobbin (4).

As shown in particular in Figures 4 and 5, the accumulator (3) consists of a hollow linear body, for

example of quadrangular cross section. The end of the body of the accumulator (3), considered on the output side, is frustoconical with a cross section that progressively decreases towards the said free end in order to create, inside the body, a buffer zone braking the output of the yarn, preventing it from leaving directly.

As shown in particular in Figures 1 and 2, this accumulator (3), after the heated godet, lies, within the treatment station in question, in an approximately vertical plane, the yarn entering the end (3b) before exiting, by simple gravity, at the frustoconical portion (3a). At this frustoconical end (3a), the accumulator (3) has a series of parallel bars (8) mounted on a support element (9) fastened, for example, to the end of the accumulator (3). The bars (8) are placed approximately perpendicular to the longitudinal axis of the accumulator (3), i.e. perpendicular to the path of the yarn, in order to carry out an uncurling function on the said yarn, giving it the tension needed for winding-on.

Other embodiments of the accumulator (3) may be envisaged. For example, it may consist of a relaxation belt in which the yarn forms a reserve. The belt is placed between the heated godet (2) and the wind-up means (4). The wind-up speed is regulated so that the amount of accumulated yarn in reserve is maintained between two predetermined values, a minimum value and a maximum value.

It should also be noted that the deposition of the yarn (5) in the accumulator (3), whatever its embodiment, may result from a relative movement between a guiding element and the accumulator (3) itself. This movement may be an alternating movement of the to-and-fro type, or else a continuous or alternating rotation. Alternatively, the relative movement is created by the

displacement of the guiding element or of the accumulator itself.

Owing to the features forming the basis of the invention, it is apparent that each treatment station comprises, in succession starting from the wind-off bobbin (6), in one and the same work position defining a small compact space, also with a yarn path of short length:

- a yarn cabling or twisting spindle (1), the presser/deliverer member (7) limiting the tension of the yarn (5) and setting a level of tension downstream;
- the heated rotary godet (2);
- the cooling accumulator (3);
- the uncurling bars (8); and
- the wind-up bobbin (4).

It is very clear that these various means may be mounted in combination with any in-line quality control system, the buffer accumulator downstream of the spindle, yarn crimping system, yarn breakage detection system, etc.

The advantages are clearly apparent from the description, in particular the following may be emphasized and recalled:

- the continuous setting of a single yarn at a time along a short path makes it possible to overcome the problem of scrap associated with dispersion in the quality of the various bobbins when they are treated jointly;
- the possibility of treating grades of yarns having a high twist;
- the increase in productivity obtained;
- the flexibility of the process;
- the control of yarn shrinkage owing to the profile of the heated godet;
- the use of an accumulator for cooling and relaxing the yarn in the completely free, tensionless

state;

- the better uniformity of the tension in the yarn resulting from a very short path of the yarn with contact points;

- the minimal distance between the deliverer and the heated godet allows better twist control before setting, avoiding short-term changes in twist; and

- the combining of the three, cabling or twisting, heat-setting and winding-on operations makes it possible to substantially reduce the management of the materials being processed.